

Estuarine Oceanography (MSCI/GEOL 581) Spring 2011 (Alternate Years)



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Course Description:

Classification of estuaries, estuarine kinematics and dynamics, major patterns of estuarine and coastal circulation, boundary layer processes, mixing, exchange and dispersion in the estuaries and in the coastal ocean.

Learning Outcome:

- Students will understand how the estuaries and the adjacent continental shelf respond to the wind-, tidal-, and buoyancy forcing, both under the steady-state and time-varying conditions.
- Students will learn how the freshwater is transported through the estuaries and on the continental shelves; mechanisms of mixing and dispersal in the estuaries and coastal ocean.
- Students will be introduced to the concepts of hydraulic control, hydraulic jump, tidal bore, buoyancy and gravity currents, shear dispersion.
- Students will recognize the role of boundary layers in generation of estuarine and coastal circulation.
- Class will yield sufficient knowledge for basic applications of the momentum and mass balance equations, for scaling analysis, for in-depth interpretation of the estuarine and coastal oceanographic data, as well as the primitive equation numerical model output.

Grades: Undergraduate students: quizzes (4 best of 6) – 20%; test 1 and 2 - 40 % each, or test 1 and 2 - 20% each and the final exam – 40%. Graduate students: quizzes (4 best of 6) – 20%; test 1 and 2 - 30 % each, and the term paper - 20%.

Undergraduate students must attend two research seminars during the semester (MSCI or DEOS) preferably related with the course subject. If not attended, the final grade will be reduced by 4%.

Final grade will be based on the following grading scale: $90 \leq \mathbf{A}$; $86 \leq \mathbf{B+} < 90$; $80 \leq \mathbf{B} < 86$; $76 \leq \mathbf{C+} < 80$; $70 \leq \mathbf{C} < 76$; $66 \leq \mathbf{D+} < 70$; $60 \leq \mathbf{D} < 66$; and $\mathbf{F} < 60$.

Class Schedule: Monday and Wednesday, 8:40-9:55, EWSC 209.

Office hours: Monday 15:00-17:00, Tuesday 11:00-12:00 or by appointment.

Useful Texts:

Baines, P. G., 1995. *Topographic Effects in Stratified Flows*, Cambridge Univ. Press, 482 pp.

Gill, A. E., 1982. *Atmosphere-Ocean Dynamics*, Academic Press, 662 pp.

Lewis, R., 1997. *Dispersion in Estuaries and Coastal Waters*, John Wiley & Sons, 312 pp.

Open University Course Team, 1999. *Waves, Tides and Shallow-Water Processes*, 2nd Edition, Butterworth-Heinemann, 227 pp.

Pedlosky, J., 1987. *Geophysical Fluid Dynamics*, 2nd Edition, Springer-Verlag, 728 pp.

Prandle, D., 2009. *Estuaries: dynamics, mixing, sedimentation, and morphology*. Cambridge Univ. Press, New York, USA, 236 pp.

Selected journal articles will be posted on the Blackboard.

Tentative Schedule

01/10/11	Introduction. Principal forcing mechanisms in the coastal ocean.
01/12/11	Shallow water equations. Long gravity waves.
01/17/11	MLK Service Day – no classes
01/19/11	Edge waves. Seiches. Tsunamis.
01/24/11	Quiz # 1. Waves of finite amplitude.
01/26/11	Waves and currents. Hydraulic control.
01/31/11	Effects of earth's rotation. Geostrophic currents. Kelvin waves.
02/02/11	Quiz # 2. Tides.
02/07/11	Tides and seiches in semi-enclosed basins.
02/09/11	Tidal propagation and dissipation in convergent estuaries.
02/14/11	Turbulent shear stress.
02/16/11	Quiz # 3. The Ekman layer.
02/21/11	Wind forcing. Storm surge.
02/23/11	Effects of bottom friction. Arrested topographic waves.
02/28/11	Test 1.
03/02/11	Effects of stratification. Internal waves.
03/07/11	Spring break.
03/09/11	Spring break.
03/14/11	Baroclinic currents. Geostrophic shear (thermal wind balance).
03/16/11	Quiz # 4. Bottom boundary layers in the stratified coastal flow.
03/21/11	Wind-driven currents. Coastally trapped waves. Coastal upwelling.
03/23/11	Fresh water discharge. Buoyancy and mixing effects in the estuary.
03/28/11	Quiz # 5. Steady-state circulation.
03/30/11	Shear dispersion.

04/04/11	Test 2.
04/06/11	No class – instructor is away. But two seminars must be attended!
04/11/11	Buoyant outflow from the estuary. Buoyant plumes. Scaling analysis.
04/13/11	Buoyancy-driven currents on the shelf. Effects of wind forcing. Gravity currents.
04/18/11	Quiz # 6. Sediment transport in estuaries and deltas.
04/20/11	Presentations by grad students.
04/25/11	Presentations by grad students.
04/26/11	Reading day.
04/27/11	14:00 Final exam (optional).